CLAIMS

What is claimed is:

1. An apparatus comprising:

a mixer to convert an RF signal to a baseband-differential signal; and

a transconductance-capacitor (GmC) filter to filter the baseband-differential signal, wherein the GmC filter comprises:

first and second transconductance-capacitor circuits in series and a transconductance-feedback circuit in feedback with the second transconductance-capacitor circuit.

2. The apparatus of claim 1 wherein at least one of either the first or second transconductance-capacitor circuits comprises:

cross-coupled pairs of transistors to receive the baseband-differential signal and generate a differential output current; and

first and second capacitors coupled respectively between differential inputs of the at least one transconductance-capacitor circuit and first and second internal-feedback nodes of the at least one transconductance-capacitor circuit.

3. The apparatus of claim 2 wherein the differential-output current is substantially proportional to a differential-input voltage of the baseband-differential signal, and

wherein the at least one transconductance-capacitor circuits further comprises:

first and second current sources coupled respectively to the first and second internal-feedback nodes to draw current through the transistors for generating the differential output current; and

a feedback resistor coupled between the internal-feedback nodes.

4. The apparatus of claim 2 wherein the capacitors are voltage-dependent capacitors, and

wherein during operation of the GmC filter, a substantially-constant bias voltage is to be maintained across the voltage-dependent capacitors to allow the voltage-dependent capacitors to provide a substantially constant capacitance.

5. The apparatus of claim 4 wherein the voltage-dependent capacitors comprise metal-oxide-semiconductor capacitors (MOSCAPs), wherein the substantially-constant bias voltage allows the MOSCAPs to be operated in a high-density and low-variation portion of the voltage-dependent capacitors' capacitance-response curve to provide a substantially constant capacitance as a function of voltage thereacross.

6. The apparatus of claim 4 wherein the transistors of the cross-coupled pairs comprise bipolar junction transistors (BJTs), and wherein the substantially-constant bias voltage is to be approximately $2V_{BE}$ during the operation of the GmC filter.

7. The apparatus of claim 4 wherein the transistors of the cross-coupled pairs comprise field-effect transistors.

8. The apparatus of claim 1 wherein the GmC filter has at least two poles, and

wherein the first transconductance-capacitor circuit is to provide a first pole for the GmC filter corresponding to an output pole of the mixer, and

wherein the second transconductance-capacitor circuit and the transconductance-feedback circuit are to provide a second pole of the GmC filter.

9. The apparatus of claim 1 wherein the transconductance-feedback circuit comprises:

cross-coupled pairs of transistors to receive the baseband-differential signal and generate a differential output current;

first and second current sources coupled respectively to first and second internal-feedback nodes to draw current through the transistors for generating the differential output current; and

a feedback resistor coupled between the internal-feedback nodes.

10. The apparatus of claim 1 further comprising:

a low-noise amplifier (LNA) to amplify and provide a received RF signal to the mixer; and

a voltage buffer to receive the filtered baseband-differential signal from the GmC filter to provide an output differential signal to an analog-to-digital converter (ADC).

11. The apparatus of claim 10 wherein the mixer is an in-phase (I) channel mixer to generate an I-channel baseband-differential signal, the GmC filter is an I-channel GmC filter and the voltage buffer is an I-channel voltage buffer to receive the filtered I-channel baseband-differential signal from the I-channel GmC filter, and

wherein the receiver further comprises:

a quadrature-phase (Q) channel mixer to generate a Q-channel baseband-differential signal;

a Q-channel GmC filter to filter the Q-channel baseband-differential signal; and

a Q-channel voltage buffer to receive the filtered Q-channel baseband-differential signal and provide a Q-channel output differential signal to the ADC.

12. The apparatus of claim 11 wherein the Q-channel GmC filter comprises:

first and second Q-channel voltage-dependent capacitors coupled respectively between differential inputs of at least one Q-channel transconductance-capacitor circuit and first and second internal-feedback nodes of the at least one Q-channel transconductance-capacitor circuit,

wherein during operation of the Q-channel GmC filter, a substantially-constant bias voltage is to be maintained across the Q-channel voltage-dependent capacitors to allow the Q-channel voltage-dependent capacitors to provide a substantially constant capacitance.

13. The apparatus of claim 10 wherein the RF signal comprises signals at either approximately 2.4 GHz or 5.0 GHz.

14. The apparatus of claim 10 wherein the RF signal comprises wideband code-division multiple access (WCDMA) signals.

15. The apparatus of claim 10 wherein the RF signal comprises orthogonal frequency division multiplexed signals having symbol-modulated orthogonal subcarriers.

16. An apparatus comprising:

first and second transconductance-capacitor circuits in series; and

a transconductance-feedback circuit in feedback with the second transconductance-capacitor circuit,

wherein at least one of either the first or second transconductance-capacitor circuits comprises:

cross-coupled pairs of transistors to receive a baseband-differential signal and generate a differential output current; and

first and second capacitors coupled respectively between differential inputs of the at least one transconductance-capacitor circuit and first and second internal-feedback nodes of the at least one transconductance-capacitor circuit.

17. The apparatus of claim 16 wherein the differential-output current is substantially proportional to a differential-input voltage of the baseband-differential signal, and

wherein the at least one of transconductance-capacitor circuit further comprises:

first and second current sources coupled respectively to the first and second internal-feedback nodes to draw current through the transistors for generating the differential output current; and

a feedback resistor coupled between the internal-feedback nodes.

18. The apparatus of claim 17 wherein the capacitors are voltage-dependent capacitors, and

wherein during operation of the GmC filter, a substantially-constant bias voltage is to be maintained across the voltage-dependent capacitors to allow the voltage-dependent capacitors to provide a substantially constant capacitance.

19. The apparatus of claim 18 wherein the voltage-dependent capacitors comprise metal-oxide-semiconductor capacitors (MOSCAPs), wherein the substantially-constant bias voltage allows the MOSCAPs to be operated in a high-density and low-variation portion of the voltage-dependent capacitors' capacitance-response curve to provide a substantially constant capacitance as a function of voltage thereacross.

20. The apparatus of claim 18 wherein the transistors of the cross-coupled pairs comprise bipolar junction transistors (BJTs), and wherein the substantially-constant bias voltage is approximately $2V_{BE}$ during the operation of the GmC filter.

21. The apparatus of claim 18 wherein the first transconductance-capacitor circuit is to provide a first pole for the GmC filter, and

wherein the second transconductance-capacitor circuit and the transconductance-feedback circuit are to provide a second pole of the GmC filter.

22. The apparatus of claim 18 wherein the transconductance-feedback circuit is a second transconductance-feedback circuit, and

wherein the GmC filter further comprises:

an input transconductance circuit; and

a first transconductance-feedback circuit in feedback with the first transconductance-capacitor circuit.

23. An apparatus comprising first and second current-mode transconductance-resistor-capacitor (GmRC) circuits to receive differential input currents respectively from first and second input transconductance circuits and to

generate differential output currents for combining respectively with differential output currents from third and fourth input transconductance circuits to generate respectively in-phase (I) channel and quadrature-phase (Q) channel output differential voltage signals.

24. The apparatus of claim 23 wherein the input transconductance circuits respectively are to receive I-channel and Q-channel differential baseband voltage signals and are to generate differential currents proportional to the received differential-baseband signals.

25. The apparatus of claim 22 wherein the GmRC circuits comprise:

a plurality of cross-coupled transistors;

first and second feedback resistors having a value of R; and

voltage-dependent capacitors DC to be biased by some of the transistors to operate in a linear region and having a value of C/2,

wherein the filter is to reject an image frequency at approximately 1/2pRC.

26. An apparatus comprising:

a plurality of cross-coupled transistors to receive a differential input current;

first and second feedback resistors coupled between some of the transistors; and

voltage-dependent capacitors to be biased by the transistors to operate in a linear region to integrate the received differential input current.

27. The apparatus of claim 26 wherein the voltage-dependent capacitors have a value of C/2, and wherein the first and second feedback resistors have a value of R, and

wherein a differential-output current is to be provided based on the differential input current, the differential-output current to be further inversely proportional to R and C.

28. The apparatus of claim 27 further comprising a plurality of current sources to draw the bias current through the plurality of cross coupled transistors and to provide a substantially-constant bias voltage across the voltage-dependent capacitors.

29. A system comprising:

an omnidirectional antenna to receive an RF signal;

in-phase (I) channel and quadrature-phase (Q) channel mixers to convert the received RF signal to baseband-differential signals; and

I and Q-channel transconductance-capacitor (GmC) filters to filter the baseband-differential signal, wherein the GmC filters comprise:

first and second transconductance-capacitor circuits in series and a transconductance-feedback circuit in feedback with the second transconductance-capacitor circuit.

30. The system of claim 29 further comprising a low-noise amplifier (LNA) to amplify and provide the received RF signal to the I-channel mixer and the Q-channel mixer.

31. The system of claim 29 wherein at least one of either the first or second transconductance-capacitor circuits comprises:

cross-coupled pairs of transistors to receive the baseband-differential signal and generate a differential output current; and

first and second voltage-dependent capacitors coupled respectively between differential inputs of the at least one transconductance-capacitor circuit and first and second internal-feedback nodes of the at least one transconductance-capacitor circuit.

32. The system of claim 31 wherein a substantially-constant bias voltage is to be maintained across the voltage-dependent capacitors to allow the voltage-dependent capacitors to maintain a substantially constant capacitance.

33. The system of claim 31 further comprising:

an analog-to-digital converter (ADC); and

I and Q-channel voltage buffers to receive the filtered baseband-differential signal from the I and Q-channel GmC filters to provide an output differential signal to the ADC.

34. The system of claim 33 further comprising an image-rejection filter to reject an image signal from the filtered baseband-differential signal from the I and Q-channel GmC filters.

35. The system of claim 34 wherein the image rejection filter comprises a first-order poly-phase filter comprising current-mode transconductance-resistor-capacitor (GmRC) circuits to receive differential input currents respectively from the first and second input transconductance circuits and generate differential output currents for combining respectively with differential output currents from third and fourth input transconductance circuits to generate I and Q output differential voltage signals.

36. The system of claim 35 wherein the input transconductance circuits respectively to receive I and Q-channel differential baseband voltage signals and to generate differential currents proportional to the received differential-baseband signals.

37. The system of claim 35 wherein the GmRC circuits comprise:

a plurality of cross-coupled transistors;

first and second feedback resistors having a value of R; and

voltage-dependent capacitors DC to be biased by some of the transistors to operate in a linear region and having a value of C/2,

wherein the image-rejection filter to at least partially reject an image frequency at approximately 1/2pRC.